

CLAIMS

What is claimed is:

1. A system for processing medical image data corresponding to a breast,
5 comprising:
 - a source of a three-dimensional data volume representing at least one physical property within the breast;
 - a processor coupled with said source to receive said three-dimensional data volume to compute therefrom a two-dimensional thick-slice image representing said at
10 least one physical property of the breast in a slab-like subvolume thereof;
 - a display coupled with said processor and displaying said thick-slice image to a viewer; and
 - an archiving device coupled with said processor to receive said two-dimensional thick-slice image, said archiving device generating an archival dataset including said two-
15 dimensional thick-slice image, said archiving device transferring said archival dataset to a tangible storage medium for archiving purposes.
2. The system of claim 1, said display further displaying a two-dimensional planar view image corresponding to said at least one physical property along a planar slice
20 within the breast, wherein said archival dataset further comprises said two-dimensional planar image.
3. The system of claim 2, wherein said at least one physical property is a sonographic property, and wherein said three-dimensional data volume is not included in
25 said archival dataset thereby promoting archival efficiency in said archiving device.
4. The system of claim 3, wherein said system passively discards said three-dimensional data volume in a circular buffer arrangement, and wherein said tangible storage medium is selected from the group consisting of: paper, film, magnetic disk,
30 optical disk, magnetic tape, and non-volatile integrated circuit memory.

5. The system of claim 2, further comprising a user input device receiving a first viewer input identifying on said thick-slice image a location of interest in the breast, wherein said planar view image corresponds to a planar slice passing through that location of interest in the breast.

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6. The system of claim 5, said user input device further receiving a second viewer input identifying said location of interest for archiving, wherein said archival dataset includes the thick-slice image and the planar view image corresponding to that location of interest.

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7. The system of claim 6, said user input device further receiving a third viewer input requesting lesion volume information for said location of interest, said display providing said lesion volume information to the viewer responsive to said third viewer input.

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8. The system of claim 5, said user input device further receiving a second viewer input identifying said location of interest for archiving, wherein said archival dataset includes the thick-slice image corresponding to that location of interest but does not include the planar view image corresponding to that location of interest.

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9. The system of claim 1, said processor computing additional two-dimensional thick-slice images corresponding to different slab-like subvolumes of the breast to form a set of thick-slice images, said slab-like subvolumes for said set of thick-slice images collectively occupying substantially all of a clinically relevant portion of the breast volume, said display displaying each of said set of thick-slice images to the viewer.

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10. The system of claim 9, said archival dataset including each of said set of thick-slice images.

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11. The system of claim 10, wherein said slab-like subvolumes have an average thickness roughly equal to about 0.5-3.0 times an expected size of lesions L to be detected according to an imaging modality of said medical image data.
- 5 12. The system of claim 11, wherein said imaging modality is ultrasound, and wherein said slab-like volumes have an average thickness lying between about 2 mm and 20 mm.
13. The system of claim 10, said display further displaying a two-dimensional planar
10 view image corresponding to said at least one physical property along a planar slice within the breast, said system further comprising a user input device receiving a first viewer input identifying on a first of said set of thick-slice images a first location of interest in the breast, wherein said planar view image corresponds to a planar slice passing through said first location of interest in the breast.
- 15 14. The system of claim 13, said archival dataset comprising a first annotation for said first thick-slice image identifying said first location of interest thereon, said archival dataset further comprising said planar view image corresponding to said first location of interest, said archival dataset being configured to facilitate simultaneous, side-by-side
20 viewing of said first thick-slice image, said first annotation, and said planar view image corresponding to said first location of interest.
15. The system of claim 14, said archival dataset being configured to facilitate simultaneous, side-by-side viewing of (i) said first thick-slice image including said first
25 annotation, (ii) said planar view image corresponding to said first location of interest, and (iii) all remaining members of said set of thick-slice images.
16. The system of claim 15, said user input device receiving a second viewer input identifying a second location of interest in the breast, said archival dataset further
30 configured to facilitate simultaneous, side-by-side viewing of (i) a thick-slice image from said set of thick-slice images upon which said second location of interest in the breast

was identified, (ii) a second annotation received corresponding to said second location of interest, and (iii) a planar view image corresponding to said second location of interest.

17. The system of claim 9, said system further comprising a user input device
5 receiving a viewer input identifying, in the event that the viewer has found no interesting locations in the breast, a most benign-looking one of said set of thick-slice images for archiving, said archival dataset including said most benign-looking one of said set of thick-slice images, said system dissociating said three-dimensional data volume and all others of said set of thick-slice images from said dataset.

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18. The system of claim 17, wherein said three-dimensional data volume and said others of said set of thick-slice images are dissociated in a passive deletion process including a circular buffer arrangement.

15 19. The system of claim 9, said processor further processing said three-dimensional data to detect anatomical abnormalities in the breast, said display annotating each thick-slice image associated with at least one detected abnormality to identify thereon a location of said at least one detected abnormality, wherein said archival dataset comprises at least each of said annotated thick-slice images and each of said associated annotations.

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20. The system of claim 19, said system being further configured to prevent the viewer from dissociating any of said annotations with associated thick-slice image.

21. A method for breast cancer screening, comprising:
25 prior to an x-ray mammogram visit to a medical clinic by a patient, accessing previously recorded medical information corresponding to that patient;
during said x-ray mammogram visit, obtaining at least one x-ray mammogram of the patient's breasts, including compressing each breast along at least one standard x-ray mammogram view plane;

comparing said previously recorded medical information to preselected qualifying criteria for determining whether the patient should receive adjunctive breast ultrasound screening; and

if it is determined at said comparing step that the patient should receive adjunctive
5 breast ultrasound screening:

acquiring volumetric ultrasound scans of the patient's breasts prior to releasing the patient from said x-ray mammogram visit, said acquiring including compressing each breast along said at least one standard x-ray mammogram view plane;

10 generating for each breast a plurality of two-dimensional thick-slice images, each thick-slice image representing sonographic properties of a corresponding slab-like volume of the breast substantially parallel to said standard x-ray mammogram view plane and having a thickness between about 2 mm and 20
15 mm; and

for each breast, viewing at least one diagnostic-quality image derived from said at least one x-ray mammogram in conjunction with one or more of said thick-slice images for detecting suspicious lesions therein.

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22. The method of claim 21, wherein said prerecorded medical information comprises prior x-ray mammogram information for said patient.

23. The method of claim 21, wherein said prerecorded medical information
25 comprises demographic information corresponding to said patient.

24. The method of claim 21, wherein said preselected qualifying criteria comprises government or insurance reimbursement qualifying criteria.

30 25. The method of claim 21, wherein said prerecorded medical information comprises a dense-breast indicator from a previous evaluation, and wherein said predetermined

qualifying criteria indicates increasingly positive adjunctive ultrasound mammography determination levels for increasingly dense-breasted patients.

26. The method of claim 22, wherein said prior x-ray mammogram information
5 includes at least one clinician assessment, and wherein, if said assessment corresponds to a predetermined threshold severity, (i) said obtaining at least one x-ray mammogram of comprises compressing each breast along at least two standard x-ray mammogram view planes, and (ii) said acquiring volumetric ultrasound scans comprises compressing each breast along said at least two standard x-ray mammogram view planes.

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27. The method of claim 25, wherein said predetermined threshold severity corresponds to a BI-RAD Category 3 Assessment indicating a suggested short-interval follow-up.

15 28. A system for processing breast ultrasound data, comprising:

a source of (i) a first three-dimensional data volume representing a sonographic property of a breast compressed along a first compression plane, and (ii) a second three-dimensional data volume representing the sonographic property of the breast compressed along a second compression plane substantially nonparallel to said first compression
20 plane;

a processor coupled with said source to receive said first and second three-dimensional data volumes to compute therefrom (i) a first set of two-dimensional thick-slice images each representing the sonographic property of the breast in a slab-like subvolume thereof as the breast is compressed along said first compression plane, and (ii)
25 a second set of two-dimensional thick-slice images each representing the sonographic property of the breast in a slab-like subvolume thereof as the breast is compressed along said second compression plane; and

an archiving device coupled with said processor to receive said first and second sets of two-dimensional thick-slice images, said archiving device generating an archival
30 dataset including said first and second sets of thick-slice images, said archiving device transferring said archival dataset to a tangible storage medium.

29. The system of claim 28, wherein said slab-like subvolumes have an average thickness between 2 mm and 20 mm.
30. The system of claim 29, said slab-like subvolumes for said first and second sets of
5 thick-slice images collectively occupying substantially all of a clinically relevant volume of the breast.
31. The system of claim 30, wherein said first compression plane corresponds to a craniocaudal (CC) view, and wherein said second compression plane corresponds to a
10 mediolateral oblique (MLO) view.
32. The system of claim 31, wherein said tangible storage medium is selected from the group consisting of: paper, film, magnetic disk, optical disk, magnetic tape, and non-volatile integrated circuit memory.
- 15 33. A computer program product stored on a tangible storage medium encoding instructions for processing breast ultrasound data, comprising
computer code for receiving (i) a first three-dimensional data volume representing a sonographic property of a breast compressed along a first compression plane, and (ii) a
20 second three-dimensional data volume representing the sonographic property of the breast compressed along a second compression plane substantially nonparallel to said first compression plane;
computer code for computing from said first and second three-dimensional data volumes (i) a first set of two-dimensional thick-slice images each representing the
25 sonographic property of the breast in a slab-like subvolume thereof as the breast is compressed along said first compression plane, and (ii) a second set of two-dimensional thick-slice images each representing the sonographic property of the breast in a slab-like subvolume thereof as the breast is compressed along said second compression plane; and
computer code for generating an archival dataset including said first and second
30 sets of thick-slice images; and

computer code for instantiating a transfer of said archival dataset to an archival medium.

34. The computer program product of claim 33, wherein said slab-like subvolumes
5 have an average thickness between 2 mm and 20 mm.

35. The computer program product of claim 34, said slab-like subvolumes for said first and second sets of thick-slice images collectively occupying substantially all of a clinically relevant volume of the breast.

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36. The computer program product of claim 35 wherein said first compression plane corresponds to a craniocaudal (CC) view, and wherein said second compression plane corresponds to a mediolateral oblique (MLO) view.

15 37. The computer program product of claim 36, wherein said archival medium is selected from the group consisting of: paper, film, magnetic disk, optical disk, magnetic tape, and non-volatile integrated circuit memory.

38. A method, comprising:

20 receiving a three-dimensional data volume representing at least one physical property within a breast;

computing from said three-dimensional data volume a two-dimensional thick-slice image representing said at least one physical property in a slab-like subvolume of the breast;

25 displaying said two-dimensional thick-slice image to a viewer in conjunction with at least one x-ray mammogram image of the breast; and

generating an archival dataset including said two-dimensional thick-slice image and including data that associates said two-dimensional thick-slice image with said at least one x-ray mammogram image.

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39. The method of claim 38, further comprising displaying a two-dimensional planar view image corresponding to said at least one physical property along a planar slice within the breast, said archival dataset further including said two-dimensional planar image.

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40. The method of claim 39, wherein said at least one physical property is selected from the group consisting of: a CT-detectable property; a PET-detectable property; and an MRI-detectable property.

10 41. The method of claim 39, wherein said at least one physical property is a sonographic property, and wherein said slab-like subvolume has a thickness in the range of 2 mm - 20 mm.

42. The method of claim 41, further comprising transferring said archival dataset to a
15 tangible storage medium selected from the group consisting of: paper, film, magnetic disk, optical disk, magnetic tape, and non-volatile integrated circuit memory.

43. The method of claim 39, further comprising receiving a first viewer input identifying on said thick-slice image a location of interest in the breast, wherein said
20 planar view image corresponds to a planar slice passing through that location of interest in the breast.

44. The method of claim 43, further comprising receiving a second viewer input identifying said location of interest for archiving, wherein said archival dataset includes
25 the thick-slice image and the planar view image corresponding to that location of interest.

45. The method of claim 44, further comprising:
receiving a third viewer input requesting lesion volume information for said location of interest;
30 automatically segmenting a lesion centered near said location of interest;

automatically computing a lesion volume metric corresponding to the segmented lesion; and

displaying said lesion volume metric to the viewer.

5 46. The method of claim 44, further comprising:

generating additional two-dimensional thick-slice images corresponding to different slab-like subvolumes of the breast to form a set of thick-slice images, said slab-like subvolumes for said set of thick-slice images collectively occupying substantially all of a clinically relevant portion of the breast volume;

10 displaying each of said set of thick-slice images to the viewer; and
including each of said set of thick-slice images in said archival dataset.